NUCLEAR SCIENCE PROGRAM
FLORIDA STATE UNIVERSITY

INTRODUCTION

The nuclear science program at FSU is characterized by the symbiotic relation between a diverse range of experimental and theoretical research. The experimental nuclear structure program (**Cottle, Fletcher, Kemper, Riley, and Tabor**) involves the study of nuclei at high spin, deformation, and isospin. Techniques involve the use of polarized Li beams, radioactive beams, and precision α-decay measurements. Much of this work is carried out at the home laboratory. Most of the radioactive beam research has been performed at the National Superconducting Cyclotron Laboratory (NSCL), and a significant part of the high spin program has used the GAMMASPHERE facility. A smaller program (**Myers**) involves precision laser spectroscopy of H and He-like atoms from the FSU accelerator. The experimental high-energy nuclear physics program (**Dennis and Frawley**) is largely carried out using the PHENIX detector at the Relativistic Heavy-Ion Collider (RHIC) and the CEBAF Large Acceptance Spectrometer at Jefferson Laboratory. In addition, we are currently recruiting on a vacant experimental nuclear physics position. The four theorists (**Capstick, Petrovich, Piekarewicz, and Robson**) have been studying baryon structure and decay, nuclear isospin, nucleon-nucleon interactions, and nuclear systems at extreme densities.

FACILITIES

The home laboratory is built around a 9 MV tandem accelerator injecting into a superconducting LINAC. The facility can accelerate ions up to mass 60 with energies of 5 to 10 MeV/AMU. Some of the unique and specialized facilities of our laboratory include an optically pumped polarized ion source which produces highly polarized, high intensity beams of ^{6}Li and ^{7}Li and a dedicated ^{14}C ion source. Detection and analysis instrumentation includes an array of 14 Compton-suppressed Ge gamma detectors (including 3 new-technology "Clover" detectors), 2 scattering chambers, 2 laser-ion beam chambers for precision spectroscopy of highly charged ions, and a 114-processor computer cluster. The university supported electronics and machine shops are valuable assets for both the home laboratory and for construction for national facilities (such as the RICH detector for PHENIX at RHIC). Another project underway is a collaboration between NSCL and both the nuclear physics group and the National High Magnetic Field lab at FSU to construct a beam sweeper magnet system for the upgraded NSCL. A companion collaboration to build a neutron detection wall is being proposed. In addition to NSCL, members of the group are involved with GAMMASPHERE and the new γ-ray tracking detection system.

BALANCE OF EFFORT

Currently, about half of the total research effort of the experimental group involves the home laboratory. Our external effort has increased perhaps 10% since the last Long Range Plan. The future balance will partly depend on the two new hires. The research programs of many of our faculty are divided between work at national facilities, such as NSCL and Gammasphere, and often complementary work at home. The home facility plays an important role even in the RHIC and JLAB programs. We simply could not have built the RICH detector without the existing infrastructure the university provides for the campus Superconducting Accelerator Laboratory. Even now after the major construction has been completed, upgrades are being designed and produced in our accelerator electronics and machine shops. The Superconducting Accelerator Laboratory has a high visibility on campus and is critical in justifying continuing university support for the entire nuclear physics program. Recent university funding for a 114-CPU computer cluster for analysis of JLAB and locally acquired data is a good example.

EDUCATION

We continue to attract top quality graduate students and aggressively recruit new students through programs such as REU and laboratory internships. The presence of an on-campus laboratory in which undergraduates can work is important in recruiting future graduate students into nuclear physics throughout the country, not just to Florida State. In the last two years, 3 undergraduates who have worked in our laboratory have been selected to give presentations at DNP meetings through the CEU program and one has received a national Goldwater Scholarship. We are currently budgeted for and support 12 experimental graduate students, although the theorists have difficulty supporting their 5 graduate students. Over the past decade we have graduated an average of 2.7 experimental Ph.D.s per year. Two of the more than 100 Ph.D. laboratory graduates since 1959 are Paul Robinson, director of Sandia Labs, and Thomas Glasmacher, Assoc. Prof. at Michigan State University. We have found that involving graduate students in research projects both in-house and at major national facilities allows them plenty of hands-on experience where they can learn from their mistakes, as well as experience with the largest detector and accelerator systems. Our recent Ph.D. graduates are listed at the end of this document.

NOTEWORTHY

Kirby Kemper received the Jesse Beams award of SESAPS, Mark Riley was appointed to NSAC and elected Chair for the 2001 Nuclear Chemistry Gordon Conference, Sam Tabor was elected to the Gammasphere Users Executive Committee, and Tony Frawley was selected to be the PHENIX Run Coordinator for the 2001/2002 run. Constructed the RICH detector for PHENIX at RHIC. Measured the first complete set of analyzing powers for a spin 3/2 system (^{7}Li), including all third rank ones. Observed the first γ transitions in $T = 5/2$ ^{27}Na using a radioactive beam (^{14}C) on a radioactive target (^{14}C). Performed the most comprehensive quadrupole measurements ever made in a superdeformed region for the $A \sim 130$ region. Investigated the behavior of ^{159,160}Er at the highest spins so far achieved in normal deformed nuclei. Completed analysis of the first measurement of $\Lambda(1520)$ electroproduction at Jefferson

Laboratory. Made the first measurement of the $2S - 2P_{3/2}$ Lamb shift in hydrogen-like nitrogen(N^{6+}) and found good agreement with QED predictions.

FUTURE

Some excellent candidates have been identified in our current search for a vacant tenure-track assistant professor position. We expect to begin recruiting soon on another position being vacated by the retirement on Neil Fletcher this summer. These two new faculty members will likely bring new initiatives which the group will support enthusiastically. One of our main initiatives in the coming years will be to continue to upgrade to more sensitive detection systems for studies of nuclear reactions and structure at ever higher spin, isospin, and deformation. This includes state-of-the-art gamma detectors, a charged particle array and neutron detectors. We are interested in extending our current research with ^{14}C beams to other radioactive beams, such as ^{10}Be and ^{17}F. We also need to continue to upgrade power supplies, vacuum pumps, He refrigeration components, and other accelerator equipment to maintain reliable operation.

STAFFING

CATEGORY	TOTAL	THEORY	EXPERIMENT
Permanent Ph.D	14	4	10
Technical/Administrative	10	0.5	9.5
Postdoctoral	5	1	4
Graduate students	17	5	12
Undergraduates	10	3	7

FUNDING

Funding for nuclear science involves cost sharing from several sources. The experimental program is primarily funded by the National Science Foundation, while the theoretical program is funded by the Department of Energy. Florida State University provides considerable support through salaries for many of the support staff, as well as matching money for capital purchases. The experimental DOE grant is intended for computational aspects of our Jlab effort, and some funds support upgrades to the RICH detector at RHIC.

YEAR	TOTAL	THEORY	EXPERIMENT	EXPERIMENT BREAKDOWN			
				NSF	FSU	DOE	RICH
FY2000	\$2422k	\$197k	\$2225k	\$1275k	\$680k	\$200k	\$70k
FY2001	\$2445k	\$200k	\$2245k	\$1275k	\$700k	\$200k	\$70k

We badly need an increase of about \$200k/year in the operating budget for an extra postdoc., extra students, and some capital for modest upgrades.

USERS

The Florida State accelerator is not funded as a user facility, but a number of visitors perform experiments on the facility, usually in collaboration with someone at FSU. In calendar 2000 visitors from Oxford University, Mississippi State University, Vanderbilt University, and Universidad Nacional de Colombia performed experiments here.

NSAC Category	NUMBER	SUPPORT	PERCENTAGE
Total	12	DOE	42%
Ph.D.	4	NSF	0%
Graduate students	6	Other	25%
Other	2	Foreign	33%

Florida State University Experimental Nuclear Physics Ph.D. Graduates

NAME	YEAR	ADVISOR	CURRENT EMPLOYER
Thomas Glasmacher	1992	Cottle	Michigan State University
Evangelos Gavathas	1993	Frawley	FL Dept. of Health & Regulation Services
Jimmy Holcomb	1993	Tabor	Lockheed-Martin Information Systems, Orlando
Tim Johnson	1993	Tabor	Paranet, Inc., Dallas
Richard Kline	1993	Dennis	Defense Intelligence Agency, Washington
Jacinto Liendo	1993	Fletcher	Universidad Simon Bolívar, Venezuela
Anthony Mendez	1993	Kemper	National Electrostatics Corporation
Phil Womble	1993	Tabor	Western Kentucky University
Edward Reber	1994	Kemper	Idaho Falls Engineering Laboratory
Mark Tiede	1994	Kemper	East Bethany, NY
Peter Green	1995	Kemper	American University, Cairo
Phil Kerr	1995	Kemper	Lawrence Livermore National Laboratory
Oswald Tekyi-Mensah	1995	Cottle	Alabama State University
Daniel Archer	1996	Riley	Lawrence Livermore National Laboratory
Glen Johns	1996	Tabor	Los Alamos National Laboratory
Keith Jewell	1997	Cottle	Idaho Falls Engineering Laboratory
Lewis Riley	1997	Cottle	Earlham College, Indiana
Eduardo Roa	1997	Fox-Lister	Argonne National Laboratory
Tim Brown	1998	Riley	Savannah River Technology Center
Timothy Drummer	1998	Kemper	University of Illinois
Daryl Hartley	1998	Riley	University of Tennessee
Robert Kaye	1998	Tabor	Purdue University, Calumet
Geoffrey Solomon	1998	Tabor	Coleman Aerospace, Orlando
Jeffrey Pfohl	1998	Riley-Sheline	Sandia National Laboratory
Robert Laird	2000	Riley	University of Wisconsin
Paul Cathers	2000	Kemper	University of Belize
Elizabeth Bartoz	2000	Kemper	Coleman Aeorspace, Orlando